

Postcovid physical rehabilitation at the sanatorium

SERGEY KOKHAN¹, SVIATLANA VLASAVA², MIKHAIL KOLOKOLTSEV³, OLEG BAYANKIN⁴, TOKHTARKISPAYEV⁵, NATALIA TROFIMOVA⁶, IRINA SUSLINA⁷, ELENA ROMANOVA⁸

¹Regional Center of Inclusive Education, Transbaikal State University, RUSSIA

²Department of Public Health and Health care, Belarusian State Medical University, Minsk, BELARUS

³Department of Physical Culture, Irkutsk National Research Technical University, RUSSIA

⁴Institute of Physical Culture and Sports, Altai State Pedagogical University, RUSSIA

⁵Department of Theory and Methodology of Physical Culture and Sports Training, Karaganda Buketov University, KAZAKHSTAN

⁶Department of Physical Culture and Health, Reshetnev Siberian State University of Science and Technology, RUSSIA

⁷Department of Philosophy and Social Sciences, GPS Emercom of Russia St. Petersburg University, RUSSIA

⁸Department of Physical Education, Altai State University, Barnaul, RUSSIA

Published online: March 31, 2022

(Accepted for publication March 15, 2022)

DOI:10.7752/jpes.2022.03076

Abstract:

New coronavirus infection caused by SARS-CoV-2 with severe complications was wide spread among the world's population and requires not only the improvement of treatment and prevention measures of the disease, but also the effective physical rehabilitation of post-COVID patients in a sanatorium. *Research aim:* to evaluate the effective-ness of early complex physical rehabilitation of persons with a post-COVID state in the sanatorium. *Research materials and methods.* The research project was carried out in «Darasun» sanatorium (Zabaikalsky Region, Russia). 33 people participated, including women 52.8±9.2 years old (n=16), men 51.5±9.0 years old (n=17), who underwent a three-week course of early complex rehabilitation immediately after discharge from a medical institutions. The milestone testing of the functional indicators of the cardiorespiratory system, physical performance was carried out, anthropometric parameters, the level of quality of life and the degree of exercise tolerance were determined. Research results. At the end of the complex health-improving and rehabilitation measures, a positive change in the activity of the cardiovascular and respiratory systems was found in all project participants. Every week there was a positive increase in the level of exercise tolerance in the 6MWD test. At the end of the third week, the number of all participants' steps increased by 50%, respiratory rate at rest decreased by 20%, blood oxygen saturation increased, blood pressure stabilized and quality of life improved by 52.5% in men and 34.8% in women, the exercise tolerance on the Borg scale became significantly higher. Conclusions. The use of an early comprehensive post-COVID program according to the proposed sanatorium physical rehabilitation protocol reduces the recovery time for people who have had a COVID infection and it is an effective method for returning patients to society.

Key Words: physical rehabilitation, post-COVID patients, sanatorium, cardiorespiratory system

Introduction

The COVID-19 pandemic caused by the mutation of the SARS-CoV-2 virus dictates the need for further scientific search for new ways to diagnose, treat, control and prevent this infection (Wu & McGoogan, 2020). The COVID-19 patients' recovery program has a long-term perspective after discharge from the clinic (Kokhan et al., 2021). That is because, despite the measures taken in the acute period, 76% of patients with a coronavirus infection, regardless of the severity of the current pathology, exhibit at least one symptom within six months of being discharged. The results of the studies showed the formation of serious complications from the respiratory system (Baigaliev et al., 2021), cardiovascular systems (Bader et al., 2021), which lead to a decrease in the quality of life and working capacity of postcovid patients (Khasanova et al., 2021).

The presence of addictive habits combined with low physical activity of the population (Kolokoltsev, et al., 2021) in the context of the COVID-19 pandemic with different modifications of the virus is a background of increased risk of severe disease (Suvama et al., 2019). The lack of a complete recovery of morphofunctional and psychophysical indicators (Maccarone et al., 2021), the steady increase in the number of postcovid patients makes it necessary to continuously monitor functional condition and physical recovery after being subjected to COVID-19.

According to scientific publications, one of the tasks of the rehabilitation of postcovid patients is to increase tolerance to physical exertion (Wang et al., 2020). It is known that aerobic physical exertions

significantly improve the functional characteristics of the organism (Mozolev et al., 2020), immune status (Aksay, 2021) and level of physical and somatic health (Daia et al., 2021). The severity of chronic human disease (De la Cámara et al., 2021). There is evidence in the scientific literature that there is a strong correlation between physical activity and COVID-19 (Adamakis, 2021). The best results of recovery of respiratory function can be obtained in the first two months after disease (Kjærgaard et al., 2020).

The SARS-CoV-2 virus is now in its fifth wave. However, the algorithm of monitoring and rehabilitation of postcovid patients using means and methods of physical activity in conditions of sanatorium has not been fully studied. Therefore, the improvement of methods of sanatorium complex physical rehabilitation is relevant at all stages of postcovid recovery (Kardeş, 2021). In Russia and other former Soviet Union republics, the term sanatorium is generally used for a combination resort/recreational facility and a medical facility to provide short-term complex rest and medical services. It is similar to spa resorts but with medical services.

Sanatorium conditions envisage the creation, implementation and control of the effective impact of natural, climatic and physical factors, optimal dosed physical and nutritional regimen, etc. It is important to note that dosed physical activity within the terrenkur (synonym: health path - a special sanatorium method of walking on paths) increases the efficiency of the cardiorespiratory system, strengthens muscles and ligaments. Aquarobics (synonyms: water aerobics, waterobics, aquarobics, aquatic fitness, aquafitness, aquafit), as a sanatorium method, improves blood circulation, respiratory, muscular and cognitive systems, hardening and enhances the immune system.

We consider it important to study the issues of the timing and speed of the functional systems recovery after severe COVID-19 and the patients' quality of life, tolerance to the physical loads in sanatorium conditions, where there are all forms and opportunities for the wellness and rehabilitation programs implementation.

Research aim. Evaluate the effectiveness of early complex physical rehabilitation of post-COVID persons' state in a sanatorium.

Material & methods

The project, which was carried out in the summer of 2021 in the «Darasun» sanatorium (Zabaikalsky Region, Russia), was attended by 33 persons who underwent a complex physical rehabilitation course immediately after treatment of complicated coronavirus pneumonia in a medical institution. Two groups were created: female group (n=16), mean age 52.8±9.2 years and male group (n=17), mean age 51.5±9.0 years. The participants' age was comparable in both groups, p>0.05.

The adapted recovery program duration at the sanatorium stage of physical rehabilitation after COVID-19 was 3 weeks (21 days) and was carried out in accordance with the individual rehabilitation plan (IRP), which took into account the patient general condition, underlying and concomitant diseases.

According to the protocol, the IRP included measures to increase the level of pulmonary ventilation (gas exchange) and "respiratory muscle pump" activity, physical load tolerance and the normalization of psycho-emotional status using physical training means and methods. Patients performed general strengthening aerobic and breathing (dynamic and static) exercises both in the gym and in the open air using street training facilities. As the patients' recovered, daily dosed walking in the Siberian coniferous forest was added to the IRP, accompanied by an instructor-methodologist along specially prepared health path routes with places to rest and information signs and stands. These are light (length up to 500 m), medium and with a significant distance. The walking pace corresponded to the functional capabilities of the patients and was recorded by a pedometer. The patients performed sound gymnastics and breathing exercises during a dosed walk. The criterion for the adequacy of the load is the ability of patients to speak without breathing during walk.

To gradually increase the physical performance of patients, therapeutic swimming, sapropel mud, hand chest massage, halotherapy, high-intensity magnetotherapy, oxygen cocktails were used. Additionally, the possibilities of local climatotherapy were also used. These are heliotherapy, aero therapy and balneotherapy (mineral drinking water therapy: using of local carbon dioxide iron-hydrocarbonate calcium-magnesium water with mineralization of 2 g/l and carbon dioxide of 3.2 g/l). Special attention was paid to nutritional treatment and the daily regime.

The maximum (SBP, mm Hg) and minimum (DBP, mm Hg) blood pressure and respiratory rate at rest were monitored upon admission to the sanatorium and at the end of the rehabilitation course. Exercise tolerance was assessed by the results of the six-minute walking dynamic working distance test (6 MHD) in meters (Casanova et al., 2011). Exercise tolerance was assessed on the Borg scale from 6 to 20 points (Borg, 1998). This technique allows describing a person's personal perception of the physical activity level. Analysis of the results of the hypoxic resistance of the organism was carried out using samples of Stange and Genche, sec. Blood oxygen saturation (SpO₂) (percentage) and was determined. The Body Mass Index (BMI) (kg/m²) was defined as the ratio of body mass in kilograms to the square of body length in meters.

The quality of life was assessed using the Russian version of the EuroQol-5D European Questionnaire for recovering from COVID-19 (Quality of Life Questionnaire (EQ-5D), 2020). The sum of the respondents' answers (in points) characterized milestone results of their psychophysical state according to five components:

mobility, self-care, everyday life activity, the pain presence or any discomfort, anxiety or depression. The presence of a high quality of patient life was assessed at 0 points, low - at 10 points.

In our project, we used licensed versions of statistical programs (STATISTICA 10.0, MS Excel 2010). Absolute numbers, relative values (%), averages and errors ($M \pm m$) represented the resulting data and statistical analysis. A level of 95% error-free prediction was considered minimally sufficient ($p < 0.05$). In accordance with the type of distribution of digital data, parametric and nonparametric methods were used. The conditions and rules for conducting this scientific project do not contradict the principles of the Declaration of Helsinki (WMA, 2013).

Results

According to the results of the study, it was revealed that before the start of physical rehabilitation in the sanatorium, many patients with COVID-19 had various complaints. They noted general weakness, rapid fatigue, shortness of breath of various degrees, including when walking and climbing stairs, muscle pain in extremities, reduced quality of life in the form of depression, headaches and dizziness, impaired cognitive memory and sleep, reduced appetite and eating habits.

At the beginning of the study, it was found that more than 30% of the project participants were patients with severe lung disease (CT-4). Before illness, 72.7% of respondents smoked, 75.8% did not engage in regular physical activity, and 63.6% had a history of concomitant non-communicable pathology.

There were no statistically significant differences between the number of men and women with this severity of COVID-19 infection ($\chi^2 = 0.1$, $p > 0.05$). In the female group BMI was $31.1 \pm 1.6 \text{ kg/m}^2$ (obesity 2 degrees), which is 15.5% more than this indicator in men - $26.3 \pm 1.5 \text{ kg/m}^2$ (overweight), $p < 0.05$. There were no statistically significant differences by gender between the values of the chest expansion indicator at rest among the project participants, $p > 0.05$.

Physical activity occupied an important place in the protocol of physical rehabilitation in a sanatorium. Performing aerobic activity (terrenkur walking) was a cardio exercise that had a positive effect on the activity of the cardiovascular and respiratory systems of the project participants. The use of this type of physical activity in mid-mountain conditions with a predominance of coniferous forests ensured the oxygen saturation of the body and psycho-emotional recovery. The results of the monitoring of physical activity in the rehabilitation process do not reveal statistically significant gender differences in the walking pace at different times from the beginning of the rehabilitation ($p > 0.05$). At the same time, all those surveyed each week showed a positive trend in the level of tolerance of physical activity using terrenkur (Fig. 1).

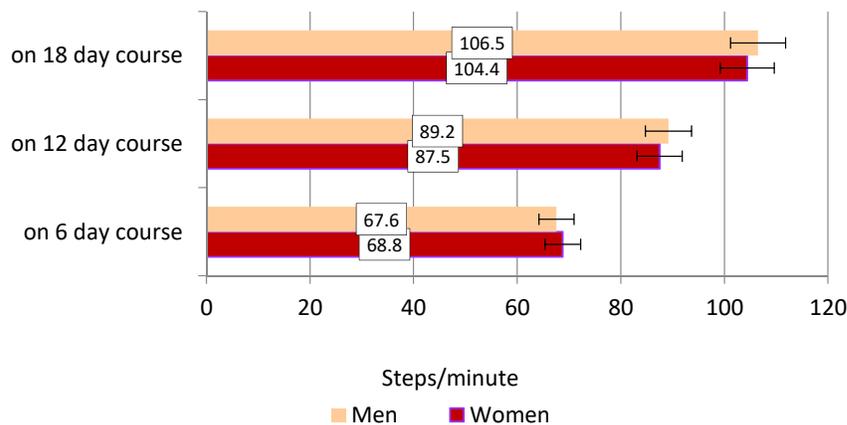


Fig.1. The dynamics of the passage of terrenkur routes in the «Darasun» sanatorium (Russia), 2021

Compared to the number of steps on the sixth day of the physical rehabilitation course, by 12 days the number of steps for women and men increased by 27.2 and 31.9%, by 18 days by 51.7% and 57.5%, respectively $p < 0.05$. It was found that three weeks after the sanatorium physical rehabilitation according the protocol, there was a breathing rate at rest reduced in women by 21.5% and in men by 22.1% (Figure 2).

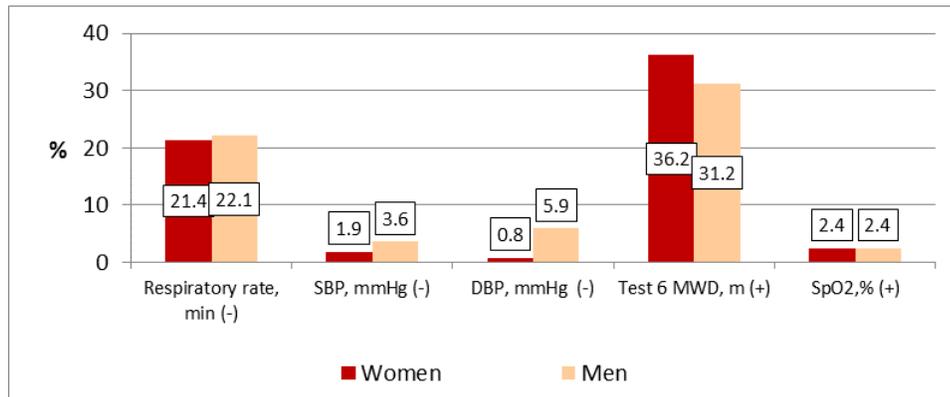
In both groups of patients, there was no significant decrease in the values of SBP and DBP at rest. A significant increase in SpO₂ and exercise tolerance (6 MWD test) to physical activity was registered in the examined population, $p < 0.05$ (table).

Table. The milestone monitoring results of the values of functional indicators and physical performance of the project participants (M±m) in the «Darasun» sanatorium (Russia), 2021

Indicators	Women		Men	
	At the beginning of the course	At the end of the course	At the beginning of the course	At the end of the course
Breathing rate at rest, breaths times per minute	21.4±1.5	16.8±0.7*	22.2±1.7	17.3±0.8*
SBP, mm Hg	117.5±8.4	115.3±6.9	131.5±10.3	126.8±8.5
DBP, mm Hg	72.8±7.3	72.2±5.2	84.1±9.9	79.1±8.9
6 MWD test, m	324.3±47.8	441.5±56.3*	352.9±49.5	463.2±58.9*
SpO ₂ , %	95.3±0.4	97.6±0.5*	94.6±0.4	96.9±0.7*

Note. * - p<0.05

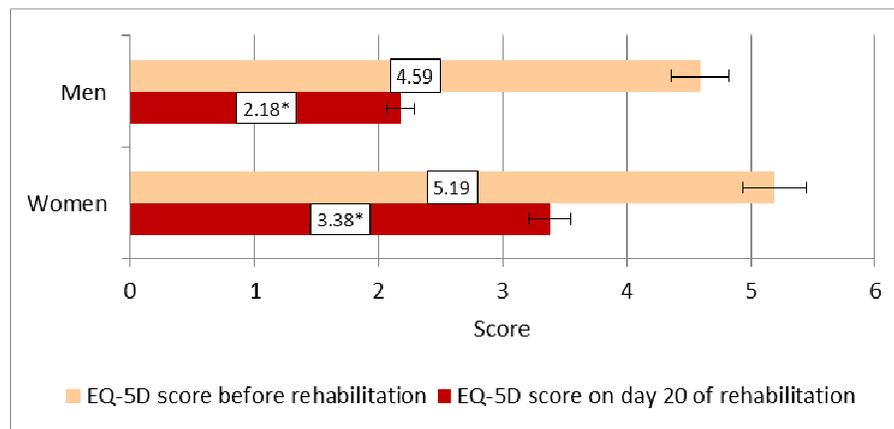
Figure 2 presents the milestone data on the rate of increase of patients' functional indicators and physical performance by the end of the research project (percentage).



Note. (-) decrease, (+) increase in indicator values

Fig.2. The patients' values of functional indicators and physical performance in dynamics by the end of the research project in the «Darasun» sanatorium (Russia), 2021

Three weeks after taking the physical rehabilitation course in the sanatorium, the value increase of the 6 MWD test for women was 36.2%. For men, the rate was 5 per cent lower (31.2 %). The SpO₂ increasing (2.4%) was approximately equal for both men and women. One of the key criteria for assessing the effectiveness of physical rehabilitation is the personal benchmark assessment of quality of life by participants in the research project on the EQ-5D questionnaire (Figure 3).



Note. * - p<0.05

Fig.3. Dynamics of milestone indicators of the project participants' quality of life in the process of physical rehabilitation in the «Darasun» sanatorium (Russia), 2021

An analysis of the results of the milestone answers indicates that at the end of the course of sanatorium rehabilitation there was a significant improvement in the quality of life indicators (EQ-5D score) in men by 52.5%, in women by 34.8%, $p < 0.05$, (Figure 3). A positive trend towards a change in the indicators of the respondents' personal exercise load tolerance (Borg scale) after passing the IRP terrenkur routes is shown in Figure 4.

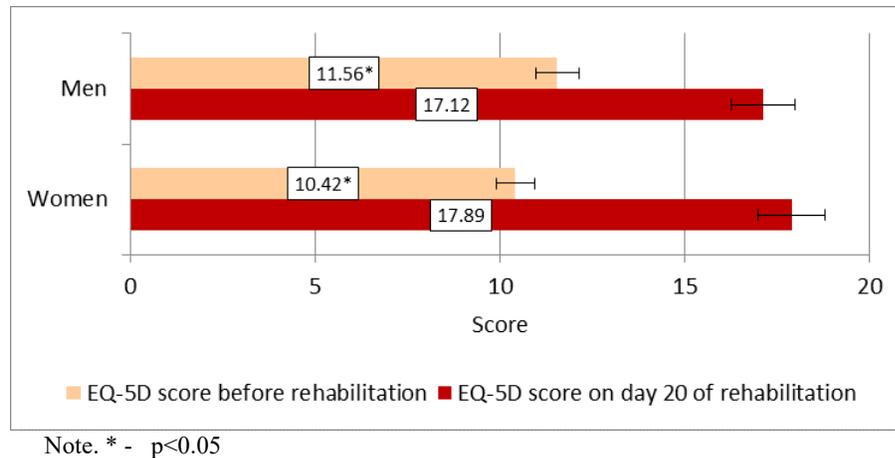


Fig.4. Dynamics of milestone indicators of the project participants' exercise load tolerance degree according to the Borg scale in the «Darasun» sanatorium (Russia), 2021

At the beginning of the rehabilitation course, the respondents of both groups rated their personal indicator of the exercise tolerance degree on the Borg scale as "very severe" - 17.12 ± 0.69 points for men and 17.89 ± 0.75 points for women. By the end of the study, this indicator significantly decreased in men by 32.8% (11.5 ± 0.6 points) and in women by 41.3% (10.4 ± 0.66 points), which corresponds to the appearance of a "moderate" degree of exercise tolerance, i.e. the respondents had an increase in the adaptive capacity of the organism, $p < 0.05$. The analysis of the results of the research project shows that in the sanatorium conditions, the restoration of the participants' functional status, physical performance, quality of life and the patients' exercise tolerance degree of recovered persons after COVID-19 have significantly improved.

Dicussion

In the modern conditions of the pandemic caused by new strains of coronary virus infection SARS-CoV-2, an important part of the programme of physical rehabilitation of postcovid patients are timely comprehensive methods and means of improving the quality of life for a full-fledged return to society. Therefore, we believe that in order to reduce postcovid consequences, the transfer of such patients after discharge from a medical institution immediately to the sanatorium conditions for a course of rehabilitation is an effective method of a continuous process of providing timely assistance. The results of our study indicate the need and effectiveness of physical rehabilitation in sanatorium conditions. The results of our research indicate the necessity and effectiveness of physical rehabilitation in sanatorium conditions. Therefore, the improvement of methods of complex physical rehabilitation in sanatorium is relevant at all stages of body recovery (Kardesh, 2021).

The results of our screening at the time of admission of postcovid patients to sanatoriums have shown that they have a low level of physical activity, obesity of the first and second degree, associated chronic diseases and harmful habits. This is consistent with the results of a survey of COVID-19 patients with arterial hypertension, heart failure, diabetes mellitus, obesity of various degrees and hypokinesia (Mitkovskaya et al., 2020). We have found that the exercise tolerance is higher among women than among men. Perhaps estrogen can be considered as a protective factor of the female organism. We consider this topic to be relevant for further research.

The possibilities of the sanatorium stage of physical rehabilitation of patients after COVID allow increasing more quickly the adaptive-compensatory capabilities of the body by non-pharmacological means (Daia et al., 2021). In the conditions of the sanatorium, physical rehabilitation methods are most preferable to reduce hypokinesia and increase the weakened by coronavirus infection aerobic capacity of the human body. The results of our study are consistent with the data of Makarova, Kirichenko (2020) on the joint effective use of a wide range of therapeutic measures and the natural and climatic conditions of the sanatorium in the early post-COVID period.

The World Health Organization (2020) reported that physical inactivity deficiency caused 3.2 million deaths worldwide. In our research project, more than 75% of COVID-19 sufferers of severe pneumonia (CT-4),

regularly did not engage in physical activity and had harmful habits prior to the onset of the disease, which confirms the pathogenic association of hypokinesia with the risk of death. According to the recommendations of the American College of Sports Medicine (Ribe et al., 2018), having a positive balance between cardiorespiratory and fitness levels is becoming a priority in a person's daily life. The effect of aerobic exercise has a positive effect on the severity of COVID-19, the reduction of immunodeficiency and the abandonment of harmful habits (Aksay, 2021). According to Suvarna et al. (2019), the main advantage of people physical activity in the context of the spread of the COVID-19 pandemic is the improvement of mental health and restoration of cognitive responses. Physical exercises have an anxiolytic and anti-depressive effect, protecting and increasing resistance to the consequences of psychosocial stress (Grajek, & Sobczyk, 2021). Overcoming physical inactivity improves the quality of human life and increases motivation for physical activity engage. The presence of physical activity (terrenkur) in training therapy contributes to the restoration and development of endurance, increases physical efficiency (Lamberti, 2021).

The appearance among the participants of our project of a weekly trend towards a positive evolution of functional status, the level of quality of life and exercise tolerance degree on early recovery post-COVID stage in sanatorium conditions, immediately after discharge from a medical institution, indicate to the effectiveness of the sanatorium stage of the rehabilitation period.

Conclusions

In the sanatorium conditions, an early stage of complex physical rehabilitation of post-COVID patients was carried out to increase the functional level of the cardiovascular and respiratory systems, exercise tolerance and quality of life. After three weeks of post-COVID individuals being in favorable climatic conditions, exposure to Siberian natural factors and physical rehabilitation, there was a decrease in the frequency of breathing rate at rest in the examined women by 21.5%, in men by 22.1%. In each gender group, SpO₂ improved by 2.4%. Exercise tolerance degree (on test 6 MWD) increased by 36.2% (women) and 31.2% (men), $p < 0.05$. The quality of life index (on EQ-5D score) significantly increased in women by 34.8%, in men by 52.5%. Personal indicator of the degree of exercise tolerance (on the Borg scale) significantly increased by 41.3% and 32.8%, respectively.

An analysis of the results of our research project showed that in order to restore the body functions and systems, physical performance and improve the quality of life, there is a need to transfer of postcovid patients immediately after acute period of treatment in the sanatorium. It reduces the duration recover period and the duration patients' return time to active social and labor activities. Early post-COVID rehabilitation in a sanatorium is an effective means of restoring health and socializing patients. We believe that the early rehabilitation period spent in a sanatorium is much more effective than that spent in an outpatient conditions.

Conflicts of interest. The authors declare no conflict of interest.

References:

- Adamakis, M. (2021). Physical activity, sleep and weight management in the COVID-19 era: a case report. *Journal of Physical Education and Sport*, Vol. 21 (1), Art 8, pp. 60 – 65. DOI:10.7752/jpes.2021.01008
- Aksay, E. (2021). Live online exercise programs during the Covid-19 pandemic – are they useful for elderly adults? *Journal of Physical Education and Sport*, Vol. 21 (4). Art 209, pp. 1650-1658. DOI:10.7752/jpes.2021.04209
- Bader, F., Manla, Y., Atallah, B., & Starling, R.C. (2021). Heart failure and COVID-19. *Heart Fail Rev.*, 26 (1), 1-10. DOI: 10.1007/s10741-020-10008-2.
- Baigaliev, A., Akhmetov, A., & Mamatova, D. (2021). Evaluation of the effectiveness of the use of complex medical rehabilitation on the functional parameters of the respiratory system in patients who underwent Covid-2019 on the basis of the municipal state enterprise (mse) on the right of economic management (rem) hospital no. 4 in Pavlodar. *The scientific heritage*, 66, 23-28.
- Borg, G. (1998). *Borg's perceived exertion and pain scales*. Human Kinetics. Champaign II
- Casanova, C.B.R., Celli, Barria, P., Casas, A., Cote, C., J.P. de Torres, Jardim, J., Lopez, M.V., Marin, J.M., M. Montes de Oca, Pinto-Plata, V., & Aguirre-Jaime A. (2011). On behalf of the Six Minute Walk Distance Project (ALAT). The 6-min walk distance in healthy subjects: reference standards from seven countries. *European Respiratory Journal*, 37, 150-156. DOI: 10.1183/09031936.00194909
- Daia, C., Ionescu, A. M., & Ionescu, E.V. (2021). Complex respiratory and motor rehabilitation program in a patient with post-pulmonary tuberculosis conditions and multiple sequelae after SARS-CoV-2 infection: case report. *Balneo and PRM Research Journal*, 12(4), 301–305. DOI: 10.12680/balneo.2021.454
- De la Cámara, M.A., Jimenez-Fuente, A., & Pardos-Sevilla, A.I. (2021). Confinement time due to the COVID19 disease: an opportunity to promote and engage people in regular physical exercise? *Transl Sports Med.*, 4(1), 3-5.
- Grajek, M., & Sobczyk, K. (2021). Well-being levels among students during the COVID-19 pandemic. *Journal of Physical Education and Sport*, Vol. 21 (4), Art 213, pp. 1682 – 1687. DOI:10.7752/jpes.2021.04213

- Kardeş, S. (2021). Public interest in spa therapy during the COVID-19 pandemic: analysis of Google Trends data among Turkey. *Int J Biometeorol.* 65, 945–950. DOI:10.1007/s00484-021-02077-1
- Khasanova, D.R., Zhitkova, Yu.V., & Vaskaeva, G.R. (2021). Post-covid syndrome: a review of pathophysiology, neuropsychiatric manifestations and treatment perspectives. *Neurology, Neuropsychiatry, Psychosomatic*, 13 (3), 93-98. DOI: 10.14412/2074-2711-2021-3-93-98.
- Kjærgaard, J.L., Juhl, C.B., Lange, P., & Wilcke, J.T. (2020). Early pulmonary rehabilitation after acute exacerbation of COPD: a randomised controlled trial. *ERJ Open Res.*, 6(1), 00173-2019. DOI:10.1183/23120541.00173-2019
- Kokhan, S., Vlasava, S., Romanova, E., Kolokoltsev, M., Balashkevich, N., Izbasarova, I., Syzdykbayev, M. (2021). Peculiarities of physical rehabilitation of patients with a severe COVID-19. *Journal of Physical Education and Sport (JPES)*, Vol 21 (Suppl. issue 6), Art 420, pp. 3155 – 3161. DOI:10.7752/jpes.2021.s6420.
- Kolokoltsev, M., Kuznetsova, L., Romanova, E., Shirshova, E., Volkov, A., Solodovnik, A., Gnilitkaya, E. (2021). Physical activity of people who recovered from. *Journal of Physical Education and Sport*, Vol 21 (Suppl. issue 6). Art 433, pp 3265 – 3272. DOI:10.7752/jpes.2021.s6433
- Lamberti, N., Straudi, S., Manfredini, R., Gasbarro, V., Zamboni, P., & Manfredini, F. (2021). Don't stop walking: the in-home rehabilitation program for peripheral artery disease patients during the COVID-19 pandemic. *Intern Emerg Med.*, 16, 1307–1315. DOI:10.1007/s11739-020-02598-4
- Maccarone, M.C., Magro, G., Tognolo, L., & Masiero, S. (2021). Post COVID-19 persistent fatigue: a proposal for rehabilitative interventions in the spa setting. *International Journal of Biometeorology*, 65, 2241-2243. DOI: 10.1007/s00484-021-02158-1.
- Makarova, N., Tsygina, T., Makarova, A., & Yablonskiy, P. (2020). Results of health-improving treatment of patients with a new COVID-19 coronavirus infection in a phthisiopulmonological sanatorium. *Medical Alliance*, 8 (3), 15-24. DOI: 10.36422/23076348-2020-8-3-15-24 (in Russian)
- Mitkovskaya, N.P., Karpov, I.A., Arutyunov, G.P., Grigorenko, Ye.A., Ruzanov, D.Yu., Statkevich, T.V., & Tarlovskaya, E.I. (2020). COVID-19 coronavirus infection (overview of international research data). *Emergency cardiology and cardiovascular risks*, 4(1), 784–815 (in Russian)
- Mozolev, O., Polishchuk, O., Kravchuk, L., Tatarin, O., Zharovska, O., & Kazymir, V. (2020). Results of monitoring the physical health of female students during the COVID-19 pandemic. *Journal of Physical Education and Sport*, 20(6), 3280-3287. DOI:10.7752/jpes.2020.s6445
- Quality of Life Questionnaire (EQ-5D). Interim Guidelines Medical rehabilitation for novel coronavirus infection (COVID-19). Approved by the Russian Ministry of Health (2020). Version 2. ConsultantPlus. Retrieved from: consultant.ru.
- Riebe, D., Ehrman, J. K., Liguori, G., Magal, M. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed). American College of Sports Medicine (Eds.). Wolters Kluwer.
- Suvarna, B., Suvarna, A., Phillips, R., Juster, R. P., McDermott, B., & Sarnyai, Z. (2019). Health risk behaviors and allostatic load: a systematic review. *Neuroscience & Biobehavioral Reviews*, 108, pp. 694-711. DOI: 10.1016/j.neubiorev.2019.12.020
- Wang, T. J., Chau, B., Lui, M., Lam, G.-T., Lin, N., & Humbert, S. (2020). PM&R and Pulmonary Rehabilitation for COVID-19. *American Journal of Physical Medicine & Rehabilitation Articles Ahead of Print*. DOI: 10.1097/PHM.0000000000001505
- WHO World Health Organization (2020). *Estrategia mundial sobre régimen alimentario, actividad física y salud – Actividad física*. Retrieved from: <https://www.who.int/dietphysicalactivity/pa/es/>
- WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. Retrieved from: http://www.ub.edu/recerca/Bioetica/doc/Declaracio_Helsinki_2013.pdf
- Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*, 323(13), 1239-1242. DOI: 10.1001/jama.2020.2648